Fall Detection of a Person in a Reverberant Environment Using Bistatic Radar

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Knowledge of the location or the movement of people on ships has a wide range of applications in commercial solutions and during the duty of state officials. Most solutions require the person to have a device that communicates with the network access points. Deploying wireless networks in confined, reflective spaces such as below-deck compartments in ships is gaining lots of interest, mainly for automatic alarm, monitoring, and safety applications. On the other hand, wireless communication is a serious challenge in the particular environment of ships. Such highly reflective environment is characterized by rich electromagnetic scattering, time and angular dispersion, and can exhibit features of a complex reverberant cavity. In that harsh environment, a fall of a person working alone to the ground can become a serious situation, if not detected in time.

The novelty of this work is based on detecting the fall of a person in such a harsh environment without any active or passive components attached. Based on the measured radio channel using the MIMOSA channel sounder [1], we first verify the reverberating nature of the environment by calculating the reverberation time in different locations inside the room. Then for the fall detection, both Tx and Rx are fixed inside the room, acting as a bistatic radar, and the radio channel is measured while a person is falling inside the room. Reflected power from moving objects causes Doppler Effect (frequency shift). The motion in the environment can be detected using the power-Doppler profile (PDP); the more movement the more Doppler spread. The time evolution of the Doppler domain is investigated by measuring the PDP over a 5 s period during which a person actually falls inside the room. A fall can be detected when a peak in the Doppler spread is captured, which marks the increasing and then decreasing speed of the fall motion. Different activities like walking and sitting were also captured for comparison. Results show that the Doppler spread for the fall event has larger peak values compared to the other normal activities.

1. P. Laly, D. P. Gaillot, M. Lienard, P. Degauque, E. Tanghe, W. Joseph, and L. Martens, “Flexible real-time MIMO channel sounder for multidimensional polarimetric parameter estimation,” in Antenna Measurements & Applications (CAMA), 2015 IEEE Conference on. IEEE, 2015, pp. 1–3.

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